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Enhancement of Pervaporation and Gas Separation Properties of Polyphenylene Oxide Membranes by Fullerene-Containing Polymer Stars

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Keywords: Mixed Matrix Membranes, Pervaporation, Gas Separation, Poly(phenylene) Oxide, Fullerene, Star-Shaped Macromolecules

Mixed matrix membranes (MMM) present an interesting approach for the ability of membrane preparation with thermal and chemical stability and mechanical strength-and improving the separation properties.

The objects of research are membranes composed of poly(phenylene) oxide (PPO) as matrix polymer modified with the different amounts (1, 3, and 5 wt %) of star-shaped macromolecules with fullerene C60 core and arms of nonpolar polystyrene (PS).

Scanning electronic microscopy (SEM), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), density determination by floatation method and definition of fractional free volume were used to characterize membranes under study. Mass transfer was studied by sorption, pervaporation and gas separation experiments.

All membranes showed high affinity to methanol and preferably permeate methanol in separation of methanol – ethylene glycol mixture in wide range of methanol concentration in feed. The separation factor through membrane increase with the rise of star-shaped macromolecules content.

Gas separation was performed using a laboratory high-vacuum apparatus with a static permeation cell with an effective area of 5.25 cm^2 at 30 °C. Gases under study were H_2, N_2, O_2, CH_4, and CO_2. Gas transport properties of all novel membranes were compared with those of known membranes by using Robeson's diagram.

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Gas Transport Properties of Fluorinated Poly(Arylene Ether)s Based on Decafluorobiphenyl

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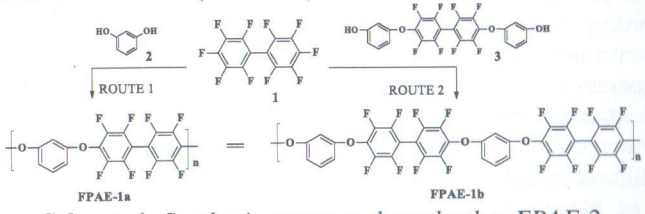
Keywords: Fluorinated Polymers, Membranes, Gas Transport Properties

Incorporation of the fluorine atoms into a polymer structure can provide many beneficial properties. Thus, fluorinated polymers are prospective materials for gas separation membrane applications.

In this work, two synthetic pathways were investigated in order to prepare meta-linked fluorinated poly(arylene ether) (FPAE-1). In a first route, such polymer was synthesized by interaction of decafluorobiphenyl (1) with resorcinol (2). In a second route, the specified polyether was synthesized by interaction of decafluorobiphenyl with 4,4'-bis(3-hydroxyphenoxy)octafluorobiphenyl (3) as initial monomer instead of resorcinol (Scheme 1).



Scheme 1. *Synthesis routes to the polyether FPAE-2.*

The *molecular weight,* mechanical, *and thermal properties of the* synthesized FPAE-1 were studied depending on the synthetic route. Gas transport properties for He, H_2, O_2, N_2, CO_2 and CH_4 gases of the synthesized fluorinated poly(aryl ether)s were investigated. FPAE-1a and FPAE-1b samples with ideal selectivity 4.4 and 4.0, respectively, approach Robeson's upper bound of 1991[th]. FPAE-1a has a more favorable combination of selectivity-permeability due to its enhanced gas permeability coefficients. Therefore, the route of polymers preparation allows regulating their microstructure that is correspondingly reflected in gas transport properties of the synthesized FPAE-1.